

NEW AMERICAN PALEOZOIC OSTRACODA.

NOTES AND DESCRIPTIONS OF UPPER CARBONIFEROUS GENERA AND SPECIES.

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The first article of this series of papers was published by Mr. Ulrich in 1900,^b when species of *Utenobolbina* and *Kirkbya* were described. Since that time Mr. Bassler has joined Mr. Ulrich in the study of these organisms and they now hope to publish papers upon this subject more frequently. Their aim in these papers will be to publish illustrations and descriptions of new families, genera and species, as well as notes upon those already established, leaving the classification and definition of the higher groups until a future time, when the fossil ostracoda can be made the subject of a monograph. All of the specimens figured in this article are in the collections of the United States National Museum.

Superorder OSTRACODA.

Family LEPERDITELLIDÆ, new family.

Genus PARAPARCHITES, new genus.

Leperditia (part) of authors.

Carapace small, 1 mm. to 2 mm. in length, leperditoid or subovate in shape; surface smooth, sometimes with a small tubercle or spine in antero-cardinal third of each valve; right valve with ventral edge rabbeted so as to slightly overlap the simply beveled edge of the left valve; dorsal edges of valves usually unequal, the left slightly the

^a Published by permission of the Director of the U. S. Geological Survey.

^b Jour. Cincinnati Soc. Nat. Hist., XIX, 1900, pp. 179-185.

more prominent and commonly overlapping the right or receiving its edge in a shallow groove.

Type of genus.—*Paraparchites humerosus*, new species.

This genus is established for the reception of the majority of the Carboniferous and Devonian ostracoda that hitherto have been referred to the genus *Leperditia*. The writers, however, are satisfied that the genetic relations of these species are not with the Ordovician and Silurian types of *Leperditia*, but rather with the group of species for which Jones proposed the name *Aparchites*. True species of *Leperditia* always attain a much greater size and their tests have a characteristically black color that is never present in the group of species for which the name *Paraparchites* is here proposed. The latter are further distinguished from *Leperditia* by the character of the ventral overlap of the valves, which is not simple but effected by means of a groove in the edge of the right valve into which the beveled edge of the left valve is received. The relation of the dorsal edges of the valves is also different in the two groups of species, the edges meeting evenly in *Leperditia* while in *Paraparchites* the back of the left valve commonly projects more or less beyond that of the right valve, and in most cases contains a groove just over the straight hinge line into which the edge of the right valve is inserted.

As expressed above and indicated by the proposed name, *Paraparchites* is regarded as closely related to and probably derived from *Aparchites*. In the latter, however, the ventral edges of the valves meet without appreciable, or, at any rate, constant overlap, and it is this difference that is chiefly relied on in distinguishing the two genera. Otherwise the general aspect of the carapace is very similar in the two groups of species, the shape and size being about the same, while the dorsal inequality of the valves is at least simulated in certain Ordovician species of *Aparchites* (e. g., *A. elliptica* Ulrich).

Paraparchites is doubtless closely related also to *Leperditella*, an Ordovician genus, the principal difference now recognized being that the ventral overlap is reversed in the two genera, the right valve overlapping in the former and the left in the latter. The inter-relations of these two genera and *Aparchites* are intimate, while their alliances with other types of ostracoda are such as to indicate a distinct family with characteristics that in a considerable degree at least are intermediate between those of the Leperditiidæ and the Beyrichiidæ. Like the latter family, the Leperditellidæ, as the new family may be called, were probably derived from some early Ordovician member or members of the Leperditiidæ, but the general or average expression of the new family is more like that of the simple types of the Beyrichiidæ. In the opinion of the writers, further, the peculiar late Paleozoic to recent genus *Cytherella* was derived from *Paraparchites* or some related genus, and hence from the Leperditellidæ.

PARAPARCHITES HUMEROSUS, new species

Plate XI, figs. 1-4.

Length of large example, 1.8 mm.; height of same, 1.25 mm.; thickness of same, 1.05 mm. Carapace subovate, with the outline slightly angulated in the antero-dorsal region; surface rather strongly convex, with greatest thickness near middle of valves. Left valve with dorsal edge straighter than in right valve, the edge in the latter being convex in outline and thickened so that it projects above the hinge line of the left valve. Ventral edge of carapace thick and slightly channeled on each side of the constant line between the valves.

This species is distinguished from all known American Carboniferous species referable to this genus, and from those from British rocks described by Jones and Kirkby as of *Leperditia*, except their *L. compressa*, in the more ovate outline of its carapace. The valves of *L. compressa*, however, are much less convex, especially in the middle parts, so that its carapace presents a very different outline in edge views when compared with the comparatively evenly convex profiles presented in corresponding views of *P. subovata*. In all the other Carboniferous Leperditidae the dorsal line is straighter and one or both of the dorsal angles much better defined.

On account of the thickening of the dorsal edge of the right valve and the rounding of the outline thereby produced, this valve may be mistaken for valves of *Cytherella* like *C. richteriana* Jones and Kirkby and *C. inflata* Jones and Kirkby.

Formation and locality.—Abundant in the Elendale formation, Manhattan, Kansas, and in yellow shales of the Wreford limestone, 6 miles west of Reece, Kansas. The species occurs also in forms generally a little inferior in size to the Manhattan specimens, very abundantly in the Permo-Carboniferous deposits of Texas, notably in certain dark shaly limestone, on Mustang Creek, east of Ballinger.

Cotypes.—Cat. Nos. 35627, 35657, U.S.N.M.

NOTES ON CARBONIFEROUS BEYRICHIIDÆ AND KIRKBYIDÆ.

The Carboniferous ostracoda that have been referred by authors to the genus *Beyrichia* are divisible primarily into two unequal groups. One of these, which of the two accords the more nearly with the Silurian genotypes of the genus, has equal valves; the other, which contains more species, has unequal valves, the left being the larger. The first group embraces species like *B. ? radiata* Jones and Kirkby, an American example of which is here figured. In this and the other species of this group, the surface of each valve presents but two rounded nodes, one larger than the other. The smaller node is situated behind the median sulcus and well down toward the base of the dorsal half of the valve. The larger node is placed more or less in

front of the center of the valve and generally its base extends farther up toward the dorsal edge and not infrequently reaches it.

Strictly speaking, these bituberculated species are not congeneric with the original Silurian types of *Beyrichia*. The latter have three nodes or lobes—a central one, usually the smallest and corresponding to the posterior (smaller) node in these Carboniferous species, a larger anterior lobe, and a posterior one that, like the anterior lobe, is generally developed into an incurving ridge. This posterior node is not developed in the bituberculated group of species in question, and as this group contains many species and represents a well-marked stage in the development of the *Beyrichiidae*, a distinct generic arrangement seems advisable. However, on account of the present uncertainty respecting the limits of such related and not well-established genera as *Beyrichiopsis*, *Beyrichiella*, and *Synaphe*, and, more especially, because it may become desirable to modify the definition of the similarly bituberculated genus *Ulrichia* so that it shall include them, it is deemed advisable to defer proposing a new genus until comparisons now in progress may be completed. It may be well to mention also that the writers have in manuscript descriptions of two late Silurian species from Maryland, having unquestionable affinities to *Beyrichia*, in which the lobation of the valves is reduced to two small, ill-defined, subcentral swellings situated on either side of a well-developed primitive sulcus.

Though variable in what are usually to be regarded as important respects, the next following species, which belongs to the larger, inequivalved group, still seems to conform in essential particulars to the British species upon which Jones and Kirkby founded not only one but three genera, namely, *Beyrichiopsis*,^a *Beyrichiella*,^b and *Synaphe*.^c Besides, a number of species that can scarcely be distinguished generically from either *Beyrichiella* or *Synaphe* are described by the same authors as true *Beyrichiæ*. Careful comparisons show that the permanent as well as the variable features of the lobation of the valves is so nearly the same in all these inequivalved forms that the present writers are inclined to doubt the necessity of more than two, instead of four, distinct genera. Indeed, if the whole assemblage were referred to a single comprehensive genus, with perhaps two or three subgenera, the arrangement would have advantages over the present classification. If the latter suggestion were adopted, *Beyrichiella* would be the main genus, *Synaphe* would drop out as a synonym, and *Beyrichiopsis* would be the subgeneric designation for the fringed species. A second subgenus, if found desirable, might then be erected for the group of species of which *Beyrichia folicata* Jones

^a Geol. Mag., 3d Dec., III, 1886, p. 434.

^b Idem, p. 438.

^c Carboniferous Ostracoda from Ireland, Sci. Trans. Roy. Dublin Soc. (2), VI, 1896, p. 190.

and Kirkby is one extreme, and *Beyrichiella bolliiformis* Ulrich and Bassler is the other.

The recognition of *Synaphe* as a synonym of *Beyrichiella* simplifies the nomenclature of the Ostracoda, since this name has been used previously for a genus of Coleoptera^a and again for a genus of Lepidoptera.^b Cossman in 1899^c proposed the new name *Kirkbyia* to replace *Synaphe* Jones and Kirkby, thereby adding to the confusion since the two names *Kirkbyia* Cossman and *Kirkbya* Jones are practically identical.

It is to be regretted that reviewers who are always on the lookout to supplant old names with coinages of their own can not take the time to go into the subject at least thoroughly enough to spare the student further trouble.

In all these unequivocal Carboniferous Beyrichiidae the lobation is, as has been stated, essentially the same. Normally it consists of a rather constant round node situated behind (according to Jones and Kirkby's orientation of the valves it would be in front of^d) the median sulcus and a larger lobe situated on the other side of the sulcus and generally nearer the dorsal edge. These nodes are susceptible to considerable variation, not only in different species, but also among individuals of one and the same species. In the most simple types, considered either as species or individuals, the valves resemble *Primitia*, they being marked by nothing further than a median dorsal sulcus. That they have no true relation to *Primitia*, however, is shown at once by the fact that the Carboniferous types in question have unequal valves, in which feature they agree with contemporaneous lobate forms whose alliances with *Primitia* are therefore obviously remote.

In less simply constructed valves the postmedian lobe is separated by a more or less impressed vertical sulcus from the broader swelling that occupies the greater part of the posterior half in the most simple types. In the further differentiation of the surface contour of the valves the antero-median lobe is similarly separated. These separations are faintly indicated in figure 18 on Plate XI, which represents about the maximum of lobation attained in *B. gregaria*. In the very

^a*Synaphe* J. Thomson, Syst. Ceramb., 1864, p. 60.

^b*Synaphe* Jacob Hübner, Verzeichniss bekannter Schmetterlinge, 1816, p. 347.

^c*Kirkbyia* Cossman, Revue Critique de Paleozoologie, III, 1899, p. 45. "*Synaphe* Kirkby 1897. Crust. Triple emploi avec *Synaphe* Hubn. Lepid. 1816, et Thoms. Coleopt. 1864, sans compter deux *Synaphe* ou *Sinaphe*. Je propose de le remplacer par *Kirkbyia*, Cossman."

^dJones and Kirkby seem to have relied uniformly on the relative thickness of the ends of the carapace in deciding which is the right and which the left valve, the thicker end being always called the posterior. The present writers, on the contrary, seek to identify corresponding nodes in related genera and species, and thereby hope to attain, first, consistent orientation, and, finally, a more natural classification of the Beyrichiidae.

similar British species, *Beyrichia arcuata* (Bean) Jones and Kirkby, the large anterior lobe seems never to be divided, but in certain other forms found in the Carboniferous rocks of England, notably *Beyrichia fastigiata* Jones and Kirkby and *B. fodicata* Jones and Kirkby, the lateral sulci are deeper, and in the latter of the two species mentioned the separation and definition of the dorsal lobes reached an extreme stage. Perhaps an even greater degree of contour differentiation is shown in Jones and Kirkby's *Beyrichia tuberculospinosa*, in which the ventral swelling that is usually a conspicuous feature in these Carboniferous Beyrichiidae is broken up into three sharply defined nodes.

These various modifications of surface contour often remind strongly of very diverse earlier Paleozoic generic types. The resemblance of the simplest forms to *Primitia* has been mentioned already. Those in the next stage, like *Beyrichia arcuata* (as figured by Jones and Kirkby), *B. craterigera* Brady, *Beyrichiopsis simplex* Jones and Kirkby, and *Beyrichiella gregaria* Ulrich and Bassler, are strikingly like *Klædenia*; and the seeming importance of this resemblance in lobation is heightened by the fact that both have similarly unequal valves. Fortunately, however, in the true *Klædenia* it is the right valve that overlaps the ventral edge of the left, while in these Carboniferous forms the opposite is the case. Another type, described here as *Beyrichiella bolliiformis*, is singularly like certain Ordovician and Silurian species of *Bollia* (e. g., *B. pumila* Ulrich); but, like the other Carboniferous species under consideration, this has unequal valves, a condition that does not occur in a true *Bollia*. Further, while in the earlier Paleozoic *Bollia* the diagnostic "loop" is a very constant feature, comparisons of numerous examples of the *Beyrichiella* show that the loop which connects the nodes in this species is most variable and in some instances is not to be distinguished at all.

How to explain these seeming diverse alliances is no easy matter. Still it is believed the explanation lies in the fact that the Beyrichiidae had entered the period of their extinction in Carboniferous times. Under such conditions it is reasonable to assume that the type was undergoing degeneration, and that this took place in the usual manner. It may be suggested, therefore, that the resemblances to earlier stages in the development of the family above noted were occasioned by reversion or by arrested development, whereby former immature stages were retained through the adult stages, and thus became the permanent specific and perhaps generic characteristics of the respective types. Whether all the inequivalved Carboniferous Beyrichiidae were derived from one or two survivals of the earlier types of the family, or whether the suggested reversions affected similarly many such survivals, is a point that it may not be possible to determine satisfactorily. Still it is believed that careful comparisons between the Devonian and Carboniferous representatives of the family will throw much light upon

the matter, and it is hoped that such studies may finally result in a satisfactory classification of the species.

The relations of the Carboniferous Beyrichiidae under consideration to *Kirkbya* are more apparent than real. At the best they rest on resemblances exhibited by what may be justly regarded as aberrant species of *Kirkbya* (e g., *K. tricollina*), or by species whose true characters and generic alliances have been misinterpreted. *K. annectens* of Jones and Kirkby (1866) is such a species. In 1896, however, the same authors made it the type of a new genus. Recognizing the resemblance shown by *K. annectens* to such widely different types as *Primitia*, *Kirkbya*, *Ulrichia*, *Drepanella*, and *Beyrichiopsis*, they proposed to distinguish it under a name "indicative of its connective character, viz., *Synaphe*." The studies of the present writers tend, in the manner already set forth, to support the observations of the British authors except that part which refers to the alliance of *Synaphe* with *Kirkbya*. The latter genus, namely, seems not to be genetically related to *Synaphe*, representing, in the writers' opinion, a distinct family that was distinguished nearly or quite as early as the true Beyrichiidae. The Kirkbyidae, as the family may be called, had its inception in such early Ordovician ostracoda as *Macronotella*. Other Ordovician and Silurian genera that should be referred to the new family are *Moorea* and *Placentula*.

As to the genus *Kirkbya*, as now understood, it doubtless is susceptible of subdivision, if indeed it may not be divided into two and perhaps three equally good generic groups. Restricting the genus to species conforming in general shape and markings to the genotype *K. permiana* Jones—a species of which in passing it may be remarked is much like the Ordovician *Macronotella*—it is evident that the trinodate forms, such as *K. tricollina* Jones and Kirkby and *K. centronata* of the present paper, are worthy of a separate generic designation. These nodate forms at first sight suggest intimate generic relations to Beyrichiidae, but it seems to the writers as more likely to be a case of mere similarity in final development. However, pending the conclusion of the detailed comparisons now in progress, it has seemed advisable to defer the suggested restriction of the genus to a more fitting opportunity.

Finally, of all the Paleozoic ostracoda, the Kirkbyidae only seem to afford the stock from which the great family Cytheridae might have been derived. Several Silurian species have been referred to *Cythere* by Jones, but it seems highly improbable that any of these is strictly referable to that genus. The same might be said of certain Carboniferous species described by Jones and Kirkby. *Cythere? haworthi* of this article is one of three species in the United States National Museum that nearly fill the requirements. Though rather obviously allied to Kirkbyidae, they are most probably Cytheridae, but whether true *Cythere* can not be decided now.

Family BEYRICHIIDÆ.

Genus BEYRICHIA McCoy.

BEYRICHIA ? RADIATA Jones and Kirkby.

Plate XI, fig. 5.

Beyrichia radiata JONES and KIRKBY, Ann. and Mag. Nat. Hist. (5), XVIII, 1860, p. 257, pl. VIII, figs. 1, 2a, 2b.

Length 1.06 mm., greatest height 0.67 mm., greatest thickness about 0.5 mm.

Valves somewhat oblique, hinge line long and straight, anterior end rounded and denticulate, posterior margin obliquely truncate, surface of valves with two rounded tubercles situated on the dorsal half, one on either side of a central depression, the anterior tubercle much larger than the posterior one. Small papillæ arranged somewhat scatteringly over the entire surface. A wide free rim or flange, often marked more or less obscurely with radiating lines, overhangs the ventral and posterior borders of the valves. Usually this rim is delicate and nearly flat, but with age it thickens and sometimes, as in the specimen illustrated, the postventral part presents a swollen appearance.

The Kansas specimens referred to this species differ in no essential respect from some of the British examples figured by Jones and Kirkby. In the specimen here figured the radial lines on the flange are very obscure, but this condition is satisfactorily accounted for by the obviously senile state of the example.

Formation and locality.—Cottonwood shales, 2 miles east of Cottonwood Falls, Kansas.

Plesiotype.—Cat. No. 35633, U.S.N.M.

BEYRICHIA ? EMACIATA, new species.

Plate XI, fig. 6.

Length 1.10 mm., height 0.68 mm.

Size, shape, and general expression about as in *B. ? radiata*, but has an emaciated look, the surface of the valves between the nodes being more sunken and the ventral portion much less tumid though ridged. A short, vertical curved ridge in the post-dorsal angle and a rim-like border along the straight back and anterior end. The flange or frill, which is bent outward at the edge, is not so wide as in *B. ? radiata*. Surface finely punctate.

With only separated valves adhering to shale it was not possible to decide whether they are equal or overlapping. If equivalved, the species belongs to the same genus as *B. ? radiata*; if inequivalved, then it would be an unusual form of either *Beyrichiella* or *Beyrichi-*

opsis. The former condition is regarded as the more likely to prove true.

Unless it is the same as White and St. John's *Beyrichia fartoidea*, which the writers have so far failed to identify, none of the known American species are sufficiently like *B.?* *emaciata* to be easily mistaken for it. It is quite distinct also from all of the British species described by Jones and Kirkby.

Formation and locality.—Yellow shales in the Wreford limestone, 6 miles west of Reece, Kansas.

Holotype.—Cat. No. 35632, U.S.N.M.

Genus BEYRICHIELLA Jones and Kirkby.

BEYRICHIELLA GREGARIA, new species.

Plate XI, fig. 18.

Length 0.95 mm., height 0.58 mm.

Valves subelliptical in outline, the hinge line nearly straight and equaling in length about four-fifths of the longest diameter of the carapace, the cardinal extremities rather obtusely angular, the two ends subequal and rounding regularly into the ventral margin. The latter part of the outline varies in different specimens, being distinctly convex in some (as in the figured example) and quite straight in the middle third in others. Except the portion of the main vertical sulcus, which is well marked and located a little behind the center of the dorsal half, the surface markings exhibit considerable variation. The sulcus may be narrow with a broad swelling on either side, as in the figured specimen, or it may be wider, the increase being at the expense of the smaller (posterior) swelling. In the former case the posterior lobe is commonly divided medially by a faint vertical sulcus, the two sulci and two intervening nodes giving an appearance that reminds us of the Silurian genus *Kladenia*. The large anterior lobe rises abruptly from the median sulcus and is always the most prominent part of the valve. Usually a small spine, occasionally of larger size than in the figure, rises from the antero-dorsal slope, while a faint vertical sulcus is sometimes distinguishable just behind the spine. A large, ill-defined, longitudinal swelling generally occupies the lower middle part of the valves, while beneath this a more or less obscure depression sets off a ventral marginal flattening or flange. This marginal flange increases in width with age, young examples which then expose the denticulated contact edge of the valve, being without it. Although entire specimens have not been seen, the characters of the separated valves leave no doubt that the left valve is the larger and overlaps the ventral edge of the right.

No American species with which this might be confused has been described. Compared with British species only *Beyrichia?* *arcuata* (Bean), as figured by Jones and Kirkby, seems near enough to require

care in discriminating between them. *B. gregaria* is proportionally higher, the anterior end especially being wider. The lobing of the valves seems to be rather more variable in the Kansas species, while no mention of the antero-dorsal spine is to be found in descriptions of *B.?* *arcuata*.

Formation and locality.—Extremely abundant on bedding planes of clayey limestone bands of the Upper Carboniferous at Kansas City, Missouri.

Holotype.—Cat. No. 35625, U.S.N.M.

BEYRICHIELLA BOLLIAFORMIS, new species.

Plate XI, figs. 7, 8.

Length 0.87 mm., height 0.52 mm., thickness 0.35 mm.

Carapace rather elongate subovate, the posterior end wider and more oblique than the anterior; cardinal angles obtuse; ends nearly equal in thickness. Surface of valves with two rounded and not very prominent nodes, subcentrally situated, one on either side of the deep median sulcus; nodes generally connected by a more or less obscure loop; posterior node rather better defined though smaller than the anterior. Ventral part of valves swollen without being definitely ridge-like. Dorsum channeled; ends and ventral edge, especially of the left valve, distinctly rimmed. Ventral edge of left valve overlapping that of the right.

The two nodes with the connecting loop impart an appearance strongly suggestive of certain species of *Bollia*. The "loop" is sometimes well defined, but in other examples it is scarcely distinguishable. The species evidently is closely related to *Beyrichia fodicata* Jones and Kirkby and *B. fastigiata* Jones and Kirkby, but its valves are relatively shorter and margined by a distinct rim, a feature not observed on the British species.

Formation and locality.—Cottonwood shales, 2 miles east of Cottonwood Falls, Kansas. The same species occurs in the Upper Carboniferous deposits in Baylor and other counties in north central Texas.

Holotype.—Cat. No. 35631, U.S.N.M.

BEYRICHIELLA BOLLIAFORMIS TUMIDA, new variety

Plate XI, figs. 9 to 11.

The form which it is proposed to designate provisionally as above differs from the typical variety of the species in two particulars. (1) the outline is somewhat rhomboidal, the anterior border being oblique, beginning to curve backward just beneath the antero-dorsal angle, and (2) the anterior third of the valve within the rim is much more tumid, this portion of the carapace being indeed decidedly thicker than the posterior part and generally exceeds even the middle thickness. Occasionally, as shown in fig. 10, the antero median node is obsolete.

It is thought possible that this variety may indicate merely a sexual phase of *B. bolliiformis*. Supposed female individuals of a number of Silurian and Devonian species of *Beyrichia* are known, but in these the tumidity is larger and much more sharply defined, and it occurs, not on one of the ends, but always on the ventral side of the valves.

Formation and locality.—Associated with, but apparently never so abundant as, the typical form of the species in Kansas and Texas.

Cotypes.—Cat. No. 35630, U.S.N.M.

Family KIRKBYIDÆ, new family.

Genus KIRKBYA Jones.

KIRKBYA PINGUIS, new species.

Plate XI, figs. 13 to 15.

Length 0.64 mm., height 0.37 mm., thickness 0.38 mm.

Carapace rather small, thick, suboblong, ends blunt in edge views, nearly equal and rounded in a side view; antero-cardinal angle obtuse, the posterior angle quite indistinguishable, ventral margin gently convex, the central portion nearly straight; dorsal outline straight in the anterior half and slightly convex in the posterior half, the latter part of the back being slightly impressed at the hinge line. Surface of valves with a subcentrally situated, rather small, and only moderately prominent node, and behind this, with a small sulcus intervening, two less conspicuous nodes placed one above the other, the larger of the two being near the post-cardinal angle. Free margins with a narrow but well-defined flat rim. Surface of test neatly reticulated, with small meshes. The diagnostic Kirkbyan "pit" is small and situated very near the center of the valve on the ventral slope of the median node.

This small ostracod is not very closely related to any described species. *K. oblonga* Jones and Kirkby and *K. lindahli* Ulrich are probably the nearest, but both are considerably larger while the valves of the former are without either nodes or a sulcus.

Formation and locality.—Cottonwood shales, 2 miles east of Cottonwood Falls, Kansas.

Holotype.—Cat. No. 35629, U.S.N.M.

KIRKBYA CENTRONOTA, new species.

Plate XI, figs. 16, 17.

Length of a large example 0.82 mm., height 0.50 mm., thickness 0.50 mm.

Carapace oblong subquadrate, with thick flattened edges, a long, straight back, and rather sharp cardinal angles, the posterior angle the less sharp of the two. Valves with a prominent large rounded node situated very near the middle of the dorsal half. On either side of this a smaller elevation surmounted by a thin curved vertical ridge in old examples. The marginal ridge, which likewise is well devel-

oped only in old specimens, is directly over the hinge but runs more or less within the free edges. Test reticulated, the pattern moderately fine. Free margins, ridges, and surface ornament all arranged more or less obviously in a concentric manner. "Pit" of moderate size though readily distinguished from the meshes of the surface ornament, situated at the base of the median node and very near the center of the valve.

Fully developed and perfect examples present a very distinctive aspect. The concentric thin ridges and general form recall the Silurian *Strepula concentrica* Jones, but taking into account only the more essential characters, the true alliances of the species are readily apparent. These are doubtless with *Kirkbya tricollina* Jones and Kirkby, a species originally described from the Lower Carboniferous limestone of Great Britain and since found in the Birdsville formation of the Chester in the Mississippi Valley. It also has 3 nodes on each valve, but the central one is smaller and the lateral ones are not ridged, while the valves are thinner and without the marginal ridge found on *K. centronata*.

Formation and locality.—Cottonwood shales, 2 miles east of Cottonwood Falls, Kansas.

Holotype.—Cat. No. 35628, U.S.N.M.

Family CYTHERIDÆ.

Genus CYTHERE Müller.

CYTHERE ? HAWORTHI, new species.

Plate XI, fig. 12.

Length 0.48 mm., height 0.29 mm.

Valves rather strongly convex, very slightly oblique, the posterior half a trifle wider than the anterior; dorsal edge long and straight, cardinal angles distinct without being sharp; ends descending rather abruptly from the extremities of the hinge, but curving broadly enough below into the ventral edge. Just behind and a little above the center of the valves is a sharply defined and prominent round node; another tubercle, more like a blunt spine and smaller, is situated near the antero-cardinal angle. A third wing-like prominence marks the posterior half of the ventral slope. Finally, a small swelling may be observed at the post-cardinal angle. Nothing like a sulcus was observed. Surface of test punctate, the punctæ being arranged in somewhat oblique longitudinal lines descending posteriorly. No pit, nor is there a sign of a marginal rim.

This minute ostracod is probably not a true *Cythere*, but its general aspect suggests more of that family than of Kirkbyidæ. It is associated with one or two other, apparently congeneric, species, while still other forms of the same general type occur in the Upper Carboniferous deposits of Texas. These should all be subjected to careful

study before a definite generic arrangement is attempted. Specifically, *C. ? haworthi* is distinguished by the ventral wing-like prominence.

Formation and locality.—Cottonwood shales, 2 miles east of Cottonwood Falls, Kansas.

Holotype.—Cat. No. 35658, U.S.N.M.

Family BAIRDIIDÆ.

Genus BAIRDIA McCoy.

BAIRDIA BEEDEI, new species.

Plate XI, figs. 19, 20.

Length 1.22 mm., height 0.75 mm., thickness 0.52 mm. Carapace thick, short, subrhomboidal in outline, lanceolate in edge views, the point of greatest thickness being near the middle; overlapping dorsal edge of left valve thick, the ventral overlap also rather wide; posterior extremity bluntly acuminate, the dorsal half of the outline nearly straight in the left valve and barely concave in the right valve, the lower half arching broadly into the ventral margin; anterior extremity less acuminate than the posterior, the outline being rounded in the lower half, nearly straight in the upper half, and abruptly bent about the mid-height. Valves unequal, the left much the larger, and the middle part of its dorsal outline distinctly convex, while the corresponding part of the right valve is sufficiently straightened to form obtuse angles at the ends of the hinge. Surface of both valves evenly convex and smooth.

This species agrees better with *B. cestriensis* Ulrich than with any other known to the writers. The principal difference lies in the shape of the posterior end, this being longer and the upper half of its outline straighter. Other differences are found in the greater dorsal overlap, in the more curved ventral edge, and in the more uniformly curved (lanceolate) outline in edge views. In young examples of the two species these differences, however, are less readily apparent than in fully developed specimens. *B. plebeia* McCoy, which of the European species is perhaps the nearest, is distinguished at once by its proportionally greater length.

The writers have a large number of specimens of *Bairdia*, apparently representing six or seven species, procured mainly from Upper Carboniferous rocks in the Mississippi Valley and Texas. Although these have not yet been subjected to critical study, it is believed that *B. beedei* occurs in some of the lots. However, pending careful comparisons, it would be unwise to attempt giving either the stratigraphic or the geographic distribution of the species.

Formation and locality.—Cottonwood shales, 2 miles east of Cottonwood Falls, Kansas.

Holotype.—Cat. No. 35634, U.S.N.M.

BAIRDIA BEEDEI ABRUPTA, new variety.

Plate XI, figs. 21, 22.

Length 1.28 mm, height 0.72 mm, thickness 0.47 mm.

Longer than the typical form of the species, but with a more abruptly tapering and therefore blunter and relatively shorter posterior end. Although the dorsal and ventral parts are nearly the same in the two varieties, the outlines of their respective smaller (right) valves seem to differ, the height at the post-cardinal angle being proportionally greater in the variety *abrupta* than in the typical variety. The last difference possibly may be, in part at least, accounted for by individual differences in the amount of dorsal overlap.

Though still too short and with blunter extremities, this variety nevertheless is much nearer *B. plebeia* McCoy than is the typical form of the species. At the same time it is farther from *B. cestriensis* Ulrich.

Formation and locality.—Associated with typical *B. beedei* and many other ostracods in the Cottonwood shales, 2 miles east of Cottonwood Falls, Kansas.

Holotype.—Cat. No. 35635, U.S.N.M.

Family CYPRIDINIDÆ.

Genus CYPRIDINA Milne Edwards.

CYPRIDINA SUBOVATA, new species.

Plate XI, fig. 23-26.

Length of an average example 3.8 mm., height 2.9 mm., thickness 2.1 mm.

Carapace compressed subglobular, broadly oval in outline, generally wider behind than anteriorly, and deeply notched in front, with a sharp beak above and a well-marked angulation below. Valves slightly unequal, the outline of the left being somewhat produced in the post-cardinal portion and therefore less regularly curved than in the right valve. In end and edge views this portion of the left valve also projects beyond the plane of the remaining portions of the edge and probably overlaps the corresponding part of the edge of the right valve. Surface of valves smooth, moderately convex, the convexity not quite symmetrical, being greater in the dorsal part than in the central and ventral portions. Partially exfoliated shells expose the muscle spot. This is ovate, radially striated, and smaller and farther removed from the center of the valves than usual. Dividing the valve into four equal parts, the whole of the scar line lies within the antero-ventral fourth.

The slight overlap of the post-dorsal edge of the left valve possibly allies this species to *Entomocochus*, in which the same valve overlaps

the right in a similar manner, only the overlap in this case occurs in the antero-dorsal region. The anterior notch, however, is much deeper and the carapace less globose in *C. suborata* than in the two species of *Entomoconchus* so far described. In its general form *C. suborata* agrees rather closely with *C. phillipsiana* Jones, but the Kansas species may be distinguished at once by its much deeper anterior notch. There are slight differences also in the size and location of the muscle spot, and in the convexity of the valves, the curves in Jones's species being more symmetrical and the carapace on the whole a little thicker and with blunter edges. *C. primæra* (McCoy), another British species, corresponds rather better in the matter of the notch and also in convexity, but differs in outline, being more produced in the post-ventral region; also in having the notch lower, which causes the beak to project considerably farther beyond the lower extremity of the notch than is the case in *C. suborata*.

Formation and locality.—Not uncommon in the Lawrence shale at Lawrence, Kansas.

Cotypes.—Cat. No. 35626, U.S.N.M.

DESCRIPTION OF PLATE XI.

Unless otherwise stated, all the figures on this plate are magnified twenty times.

FIGS. 1-4. *Paraparchites humerosus*, new genus and species.

- FIG. 1. Right valve showing general form of a rather large but otherwise average carapace.
- 2. Anterior view showing overlap of right valve dorsally, and slight ventral overlap of left valve.
- 3. Ventral view of same.
- 4. Interior of a right valve exhibiting dorsal prominence and linear socket for reception of corresponding portion of left valve.

Elendale formation, Manhattan, Kansas.

FIG. 5. *Beyrichia? radiata* Jones and Kirkby.

- FIG. 5. Right valve of an old example apparently agreeing in all essential respects with the English types of the species.

Cottonwood shales, 2 miles east of Cottonwood Falls, Kansas.

FIG. 6. *Beyrichia? emaciata*, new species.

- FIG. 6. Right valve showing the sharply defined lobes and ridges and generally emaciated appearance characterizing this species.

Wreford limestone, 6 miles west of Reece, Kansas.

FIGS. 7, 8. *Beyrichiella bolliiformis*, new species.

- FIG. 7. Left side of an entire carapace of the typical form of the species.

- 8. Dorsal view of same anterior end to left, showing the channeled back.

Cottonwood shales, 2 miles east of Cottonwood Falls, Kansas.

FIGS. 9-11. *Beyrichiella bolliiformis tumida*, new variety.

- FIG. 9. Left valve incomplete at the antero-dorsal angle. In this specimen the surface markings are very much as in the typical form of the species, but the whole anterior end is much more inflated.

10. Another left valve having the anterior swelling characterizing the variety but differing from other specimens in the obsolescence of the anterior one of the two median tubercles.
11. Ventral view of original of fig. 10, showing the inflation of the anterior end.

Cottonwood shales, 2 miles east of Cottonwood Falls, Kansas.

FIG. 12. *Cythere? haworthi*, new species.

- FIG. 12. View of left valve showing the ventral wing-like process, the tubercles and surface markings characterizing this minute species.

Cottonwood shales, 2 miles east of Cottonwood Falls, Kansas.

FIGS. 13-15. *Kirkbya pinguis*, new species.

- FIG. 13. Left side of an example retaining both valves.

14. Posterior view of same specimen.

15. Ventral view of same.

Cottonwood shales, 2 miles east of Cottonwood Falls, Kansas.

FIGS. 16, 17. *Kirkbya centronota*, new species.

- FIG. 16. Right valve of a fully developed and well-marked example showing the concentric arrangement of the ridges and reticulate ornament, and the strongly developed dorsal ridge.

17. Anterior view of same showing the thick dorsal and ventral edges.

Cottonwood shales, 2 miles east of Cottonwood Falls, Kansas.

FIG. 18. *Bevrichiella gregaria*, new species.

- FIG. 18. Left valve of an average old example of this rather variable species. In young valves the obscurely defined ventral flange is much narrower or is wanting, and in such cases the denticulated contact edge beneath may be visible in a side view.

Coal Measures, Kansas City, Missouri.

FIGS. 19, 20. *Bairdia beedei*, new species.

- FIGS. 19, 20. Right side and ventral views of a complete example. End view about as in figure 22.

Cottonwood shales, 2 miles east of Cottonwood Falls, Kansas.

FIGS. 21, 22. *Bairdia beedei abrupta*, new variety.

- FIGS. 21, 22. Views of right side and posterior end showing the more abruptly tapering posterior portion that distinguishes the variety. Edge view about as in figure 20.

Cottonwood shales, 2 miles east of Cottonwood Falls, Kansas.

FIGS. 23-26. *Cypridina suborata*, new species.

- FIG. 23. Left valve, with the test somewhat exfoliated, so as to show the muscular scar, $\times 6$.

24. Dorsal outline of same, showing postero-cardinal projection.

25. Posterior view in outline of same, likewise showing the post-cardinal projection of margin supposed to indicate a limited overlap of valves.

26. Right valve drawn from a gutta-percha squeeze, $\times 6$, showing slight difference in outline of post-cardinal portion when compared with left valve.

Lawrence shales, Lawrence, Kansas.